[redacted]

ST 15527-63K H
TCS-1201-63/KH
14 March 1963

Copy 2

INFO COPY

MEMORANDUM FOR: Director, National Reconnaissance Office

SUBJECT: Distribution of KH-6 Technical Data

KH-6

REFERENCE: [redacted]09

1. The reference is a request from NRO for sample formats, distribution procedures, timing, and definitions pertaining to technical data and ephemeridies to be prepared and distributed by NPIC for each KH-6 mission. Mr. [redacted] NRO, has informally discussed this request with NPIC personnel.

2. Attachment 1 is a sample format of Technical Data which is distributed by cable approximately 36 hours after recovery. Additional calibration data relative to orientation relationships of panoramic camera, stellar-index cameras, vehicle axis and attitude sensors has been requested and is included if available. Appropriate definitions pertaining to items included in this cable are:

a. Operational Focal Length: The distance from the main lens nodal point to the film surface as measured on the lens bench and the data reduced for a vacuum condition (equivalent focal length corrected for environment).

b. Knee Angle: Angle between axes of stellar and index cameras.

c. Yaw Tables: There will be a unique yaw program to compensate for coriolis force for each possible inclination angle to be used in the KH-6 system. Attachment 2 is a set of yaw tables. These tables consist of latitude in increments of five degrees and the corresponding programmed yaw. The mission technical data cable will include the inclination angle used for the mission (Item G). With this information the programmed yaw for any latitude can be determined.

	ACT	INF
SS-1		
SS-2		
SS-3		
SS-4		
SS-5		
[redacted]		

3. A Preliminary Frame Ephemeris containing items (A) through (R), Attachment 3, is distributed in a bound machine tabulation at approximately the same time that the film is distributed. Items (K), (Q) and (R) may not be included for the first mission or two. As this involves

GROUP 1
Excluded from automatic
downgrading and
declassification

a new procedure there may be some delay in distribution for the first mission. If an undue delay occurs, an Orbit Ephemeris, similiar to that distributed for the KH-4 program, providing orbital data at one minute intervals, will be distributed approximately six days after recovery. Attachment 4 contains definitions of the orbital elements included at the end of the tabular data for each revolution in the Orbit Ephemeris. Attachment 5 contains definitions of terms appearing in the Frame Ephemeris.

4. A Final Frame Ephemeris is distributed approximately one month after recovery. This ephemeris contains the items included in the Preliminary Frame Ephemeris plus pitch, roll and yaw computed from the Stellar photography. Any errors in the time as recorded on the data block are corrected and the various items adjusted accordingly.

5. Calibration data relative to the Stellar-Index cameras and reseaus is disseminated by NPIC upon receipt from ACIC where the calibrations are performed.

Arthur C. Lundahl
A. C. LUNDAHL
Director
National Photographic Interpretation Center

Attachments:
1 - Sample Format of Technical Data
2 - Set of Yaw Tables
3 - Contents of Frame Ephemeris
4 - Orbital Elements
5 - Definition of Terms

ATTACHMENT 1
TCS-1201-63/KH
ST15537-63KH

SAMPLE FORMAT OF TECHNICAL DATA

THE FOLLOWING INFORMATION IS FROM THE NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER.

SUBJECT: TECHNICAL DATA FOR KH-6 MISSION ___________

1. THE FOLLOWING TECHNICAL DATA NECESSARY FOR THE REDUCTION OF QUANTITATIVE INFORMATION FROM PHOTOGRAPHY OF MISSION _________ IS FORWARDED FOR YOUR USE.

A. THIS PHOTOGRAPHY INVOLVES THE USE OF THREE CAMERAS: ONE PANORAMIC CAMERA, ONE STELLAR CAMERA AND ONE INDEX CAMERA.

B. OPERATIONAL FOCAL LENGTH
  1. PANORAMIC
  2. STELLAR
  3. INDEX

C. LENS DISTORTION
  1. PANORAMIC

D. CALIBRATION DATA
  1. PANORAMIC FORMAT
    A. FORMAT LENGTH
    B. FORMAT WIDTH
    C. DISTANCES BETWEEN FIDUCIALS
  2. STELLAR-INDEX KNEE ANGLE
  3. LOCATION OF PRINCIPLE POINT
    A. STELLAR
    B. INDEX

E. EXPOSURE DATA
  1. PANORAMIC CAMERA
    A. FILM

GROUP 1
Excluded from automatic downgrading and declassification

B. APERTURE

C. SLIT WIDTH

D. FILTER

2. STELLAR CAMERA

A. FILM

B. APERTURE

C. EXPOSURE

D. FILTER

3. INDEX CAMERA

A. FILM

B. APERTURE

C. EXPOSURE

D. FILTER

F. RESOLUTION DATA

1. PANORAMIC CAMERA (DYNAMIC L/MM AVG)

2. INDEX CAMERA (L/MM AWAR)

G. INCLINATION ANGLE (REFER TO YAW TABLES FOR VALUE OF PROGRAMMED YAW)

H. IMC DATA

1. TYPE RAMPS USED (COSINE OR LINEAR)

2. RAMP RATES

RAMP NO. (COSINE EXAMPLE)

	BEGIN	CENTER
CYCLE PERIOD (SEC)	____	____
IMC VELOCITY ("/SEC)	____	____
SCAN VELOCITY ("/SEC)	____	____

ATTACHMENT 1
TCS-1201-63/KH

RAMP NO. (LINEAR EXAMPLE)

	BEGIN	END
CYCLE PERIOD (SEC)	____	____
IMC VELOCITY ("/SEC)	____	____
SCAN VELOCITY ("/SEC)	____	____

(ITEMS I THROUGH T IN TABULAR FORM)

I. ROLL STEERING POSITION

J. OPERATION (PASS NO., TYPE, MODE)

K. LATITUDE CENTER OF BLOCK (HUNDREDTHS OF A DEG)

L. LONGITUDE CENTER OF BLOCK (HUNDREDTHS OF A DEG)

M. BLOCK NUMBER

N. SUN ALTITUDE (DEG)

O. CAMERA ON (GMT, DAY, HOUR, MINUTE)

P. EXPOSURE (MILLISECONDS)

Q. RAMP USED

R. CAMERA ON TIME UP RAMP (SEC)

S. CAMERA OFF TIME UP RAMP (SEC)

T. STELLAR INDEX DATA

1. OPERATION /SLAVED TO PAN (SL) OR INDEPENDENT (ID)7
2. CAMERA ON TIME (HR & MIN)
3. LATITUDE OF CAMERA ON (DEG)
4. NUMBER OF EXPOSURES

U. SYSTEM TIME TO CLOCK TIME CORRELATION

1. PASS NUMBER
2. SYSTEM TIME (GMT - MIL SEC)
3. CLOCK TIME (MIL SEC)

ATTACHMENT 2
TCS-1201-63/KH
ST15527-63KH

YAW TABLES

INCLINATION: 65 DEGREES

Geodetic Latitude Degrees	Vehicle Yaw Angle Degrees
0	+3.25
5	+3.23
10	+3.18
15	+3.10
20	+2.99
25	+2.85
30	+2.68
35	+2.49
40	+2.26
45	+2.00
50	+1.71
55	+1.37
60	+ .95
65	+ .15
65	- .15
60	- .94
55	-1.35
50	-1.68
45	-1.97
40	-2.22
35	-2.43
30	-2.62
25	-2.78
20	-2.91
15	-3.02
10	-3.09
5	-3.14
0	-3.16

INCLINATION: 70 DEGREES

Geodetic Latitude Degrees	Vehicle Yaw Angle Degrees
0	+3.36
5	+3.34
10	+3.29
15	+3.21
20	+3.11
25	+2.97
30	+2.82
35	+2.63
40	+2.42
45	+2.18
50	+1.91
55	+1.62
60	+1.28
65	+ .87
70	+ .13
70	- .13
65	- .87
60	-1.27
55	-1.59
50	-1.88
45	-2.14
40	-2.36
35	-2.57
30	-2.74
25	-2.89
20	-3.02
15	-3.12
10	-3.19
5	-3.24
0	-3.27

ATTACHMENT 2
TCS-1201-63/KH

INCLINATION: 75 DEGREES

Geodetic Latitude Degrees	Vehicle Yaw Angle Degrees
0	+3.44
5	+3.42
10	+3.37
15	+3.30
20	+3.19
25	+3.07
30	+2.91
35	+2.73
40	+2.53
45	+2.31
50	+2.06
55	+1.79
60	+1.49
65	+1.17
70	+ .78
75	+ .10
75	- .10
70	- .78
65	-1.15
60	-1.47
55	-1.76
50	-2.02
45	-2.26
40	-2.47
35	-2.66
30	-2.83
25	-2.98
20	-3.10
15	-3.20
10	-3.27
5	-3.31
0	-3.33

INCLINATION: 82 DEGREES

Geodetic Latitude Degrees	Vehicle Yaw Angle Degrees
0	+3.50
5	+3.48
10	+3.43
15	+3.36
20	+3.26
25	+3.14
30	+2.99
35	+2.82
40	+2.63
45	+2.41
50	+2.18
55	+1.93
60	+1.66
65	+1.38
70	+1.08
75	+ .75
80	+ .36
80	- .36
75	- .74
70	-1.07
65	-1.36
60	-1.64
55	-1.90
50	-2.14
45	-2.36
40	-2.56
35	-2.75
30	-2.91
25	-3.05
20	-3.17
15	-3.26
10	-3.33
5	-3.37
0	-3.39

GROUP 1
Excluded from automatic
downgrading and
declassification

ATTACHMENT 3
TCS-1201-63/KH
ST15527-63KH

CONTENTS OF FRAME EPHEMERIS

A. PASS NUMBER

B. DATE OF PASS

C. FRAME NUMBER

D. TIME OF EXPOSURE (MIL SEC)

E. TIME DIFFERENCE (MIL SEC BETWEEN EXPOSURES)

F. LATITUDE OF CAMERA NADIR (TO HUNDREDTHS OF A MIN)

G. LONGITUDE OF CAMERA NADIR (TO HUNDREDTHS OF A MIN)

H. ALTITUDE (FT)

I. GROUND VELOCITY (FT/SEC)

J. AZIMUTH (DEG & MIN)

K. SUN ALTITUDE (DEG & MIN)

L. BURST (MONO OR STEREO AND SEQUENTIAL POSITION OF THE FRAME WITHIN THE BURST)

M. CAMERA ROLL POSITION (+30°, +15°, 0, -15°, -30°)

N. MIRROR POSITION (FWD, VERT, AFT)

O. PITCH (DEG & MIN)

P. ROLL (DEG & MIN)

Q. LATITUDE OF CENTER OF FORMAT (TO HUNDREDTHS OF A MIN)

R. LONGITUDE OF CENTER OF FORMAT (TO HUNDREDTHS OF A MIN)

S. YAW (DEG AND MIN)

GROUP 1
Excluded from automatic
downgrading and
declassification

ATTACHMENT 4
TCS-1201-63/KH
ST/5527-63KH

ORBITAL ELEMENTS

The orbital elements are included at the end of the tabular data for each revolution in the Orbital Ephemeris.

a. EPOCH: The time of the terminal ascending node of the revolution; consequently, the time of the initial ascending node of the succeeding revolution.

b. LONG ASC NODE: The longitude coordinate on the node at the time of the EPOCH, measured Westward from Greenwich.

c. INCL: The angle between the orbital plane and the equatorial plane measured counter-clock-wise from equator to orbit looking down on the ascending node.

d. ECCEN: The eccentricity of the ellipse approximating the orbital path, equals (APOGEE-PERIGEE)/(APOGEE + PERIGEE).

e. PERIOD: The time between ascending nodes of the approximating ellipse.

f. DECAY: The rate of change of the period defined in (e).

g. PERIGEE: The distance from the center of mass of the earth to the vehicle measured at perigee.

h. ARG PER: The angle along the orbital path, about the geometrical center of the Hough ellipsoid measured from the ascending node in the direction of flight to perigee (to the perifocal direction.

i, APOGEE: The distance from the center of mass of the earth to the vehicle measured at apogee.

GROUP 1
Excluded from automatic
downgrading and
declassification

~~TOP SECRET~~

ATTACHMENT 5
TCS-1201-63/KH
ST15527-63KH

FRAME EPHEMERIS DEFINITIONS

1. Z OR UNIVERSAL TIME

HR MIN: GMT (based on WWV) on a 24 hour basis from Midnight at Greenwich.

2. LATITUDE

Reference the Hough ellipsoid: The angle between a line through the vehicle and the equatorial plane; the line being perpendicular to the Hough ellipsoid at its intersection with the ellipsoid.

3. LONGITUDE

The longitude, based on Greenwich, of the intersection of the Hough ellipsoid perpendicular. This also is the longitude of the radial line from the geometrical center of the Hough ellipsoid.

4. ALTITUDE

The distance from the vehicle to the Hough ellipsoid measured along the radial line to the geometrical center of the Hough ellipsoid.

5. GROUND VELOCITY

Ground speed of the nadir point.

6. AZIMUTH

The angle between the projection of the velocity vector on a non-rotating sphere (about the center of the mass of the earth) and the local meridian of longitude. The convention adopted is North = 0°, East = 90°, South = 180°, West - 270°.

GROUP 1
Excluded from automatic
downgrading and
declassification

HANDLE VIA TALENT-
KEYHOLE CHANNELS
ONLY

~~TOP SECRET~~

SPECIAL HANDLING

ATTACHMENT 5
TCS-1201-63/KH
ST5522-63/KH

7. BURST

Block of 16 frames (16 vertical or 8 forward and 8 aft)

8. YAW

Yaw is equivalent to an azimuth angle and is measured between the plane of the orbit and the principal plane. It is positive when the camera is rotated to the left as seen from above.

9. PITCH

Pitch is measured in the vertical plane containing the y-axis, and it is positive when the positive y-axis is above the horizontal plane (a plane parallel to one tangent to the earth at the nadir). Note that the y-axis and the "pitch plane" are aligned to the direction of flight only when yaw is zero.

10. ROLL

Roll is measured in a plane containing the x-axis and is perpendicular to the plane of the photograph. It is positive when the positive x-axis is above the horizontal plane. The "roll plane" is vertical only when pitch is zero, and it is perpendicular to the flight direction only when yaw is zero.

NOTE: The following rotations will be used to describe the attitude of the cameras. Yaw, pitch, and roll will be orthogonal ? rotations where:

(a) Yaw is primary
(b) Pitch is secondary
(c) Roll is tertiary